PROCEEDINGS OF THE
2023 SOUTHWEST FLORIDA CLIMATE SUMMIT

Opening Remarks

Senator Marco Rubio, molly_clifford@rubio.senate.gov
284 Russell Senate Office Building, Washington, DC 20510

Session 1 – Regional Climate Stressors

Regional Climate Stressors: Rainfall Extremes

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As part of SFWMD's efforts to continue to protect freshwater resources and ecosystems and build resilience in the face of climate stressors, the District entered into a cooperative agreement with the United States Geological Survey (USGS) Caribbean–Florida Water Science Center and the FIU Sea Level Solutions Center to support the delineation and selection of future extreme rainfall scenarios for flood adaptation planning, based on available global climate model downscaled datasets. The results of the USGS-FIU-SFWMD study present a range of future rainfall change factors, representing the calculated ratio (and uncertainty) of modeled future rainfall depths to historic rainfall depths for a given rainfall event. Future extreme rainfall conditions, along with sea level rise and land development scenarios, is now integrated into flood vulnerability assessments being advanced by the District's Flood Protection Level of Service Program, and other regional and local hydrological/hydraulic model simulations that estimate flood risks driven by extreme rainfall, and support adaptation planning. On the other side of extremes, the District is also looking at characterizing drought vulnerability and assessing future conditions, in the context of sustainable water supply sources for our communities and the

environment. Managing wet and dry rainfall extremes requires continuing investments in water storage options, along with other Ecosystem Restoration and adaptation strategies.

Evapotranspiration

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An overview of evapotranspiration will be presented. Evapotranspiration is the combination of evaporation and transpiration, where liquid water is turned into water vapor. Evaporation is driven by the sun's energy and results in the movement of water from the surface of lakes, rivers, and moist soil back to the atmosphere. Transpiration returns water to the atmosphere through the stomata of plant leaves. Evapotranspiration rates are sensitive to the changes in air temperature, solar radiation (affected by clouds) and water vapor in the atmosphere (humidity), as well the availability of water on the surface (such as in lakes) or in soil layers. Increases in concentrations of greenhouse gases have a more complex effect on evapotranspiration. For example, reduced transpiration of plants from increased carbon dioxide concentrations can be offset by increased evaporation due to rising air temperature.

Evapotranspiration can be estimated using ground-based or satellite sensors. Evapotranspiration is a large part of the water budget for Florida. Annual precipitation in Florida averaged about 57 inches over the years 2000–2020 while evapotranspiration is estimated to be about 42 inches for that same period. Once evapotranspiration is accounted for, about 15 inches of precipitation remains for river runoff, recharge of groundwater, and other water consumption.

Coastal Acidification Around Florida

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Coastal acidification is a water quality issue. When there is excess carbon dioxide in the water, the chemical reaction between carbon dioxide and water forms an acid (that reduces the pH of the water). This carbon dioxide can come from several sources including nutrient contamination, sewage, runoff, decomposition of organic matter from, for example, the die-off of harmful algal blooms, and adsorption of carbon dioxide from the atmosphere. Rivers and other freshwater sources naturally have more acidic conditions than ocean water and can also be a source of acidity. As ocean and coastal surface temperatures increase, the amount of acid that forms from carbon dioxide can also increase. Therefore, global temperature increases can have a compounding effect on the acidity of the water. When the acidity of the water gets too high, there could be negative impacts on fish and shellfish. Our current understanding of the state of acidification across the Southeast and Gulf of Mexico regions is limited.

The Southeast Ocean and Coastal Acidification Network (SOCAN) and the Gulf of Mexico Coastal Acidification Network (GCAN) have joined together to try to understand how communities may be vulnerable to acidification and where acidification could impact us most. Recently, a national initiative was launched to gather information about which species of fish and shellfish have been studied under acidic conditions, the potential impact acidification could have on local economies, and geographic locations that are currently monitored for acidification.

In support of this initiative, SOCAN and GCAN, are collecting information from residents across the Southeast and Gulf of Mexico regions on their understanding of acidification, where they think monitoring sites should be located, and what types of education are needed to help decrease our vulnerability to acidification. Please visit www.socan.secoora.org/gcan to take the survey and contribute to the results of this project.

Regional Watershed Changes: Restoring For The Future

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As climate changes, so too does our watersheds and the movement of water through land, oceans, and atmosphere. New work is being done to provide information about the future of the water cycle as well as the impacts to aquifers, rivers, wetlands and watersheds we are dependent upon. The Coastal & Heartland National Estuary Partnership (CHNEP) identified restored hydrology (water flow underground and across the landscape) as an key factor in creating healthy natural systems with appropriate freshwater flows to sustain ecosystems and communities. However, significant challenges remain to reverse damage from development and balance limited water resources between people and natural ecosystems. On top of that, climate change related impacts such as reductions in freshwater flows, alterations in rainfall patterns, changes to wetland hydroperiods, evapotranspiration and sea level rise will also need to be addressed.

Recently, CHNEP has created watershed restoration models for areas in Southwest Florida with the goal to 'get the water right', identifying what needs to happen to restore and maintain our water supply, flood protection, water quality and water-dependent resources in the face of existing degradation and depletion, climate change factors, and continued regional growth. These strategic hydrological planning tools used the best available surface water, groundwater, climate and rainfall data to develop integrated surface and groundwater hydrological models to simulate the water cycle in the natural environment. The models identify how changes to the landscape and environmental conditions will impact where surface and groundwater will move in response to a changing climate, as well as illuminate what planned restoration efforts will be most impactful in restoring the hydrology in our watershed while maintaining or improving flood protection in our communities.

By focusing attention and resources on a landscape-level strategies and restoration projects, greater cost-benefits can be achieved. However, due to the large scale, complexity, and cost of implementing these large-scale projects, a multi-partner phased approach will be required that will span years if not decades. This means continued long-term coordination will be needed between agencies that manage water as well as and local, state, and federal governments. National Estuary Program entities work regionally as a collaborative of governmental, non-profit and community partners, which well positions them to assist coordination of partners to make strategic decisions for the future- and furthering climate readiness through forward-looking research and restoration. Having science-based information on how watershed will change in response to changing climate conditions provides the basis to build sustainable hydrological restoration projects with lasting benefits.

Session 2 – Climate and Hurricane Ian

The Rapid Attribution of the Climate Change Impact on Hurricane Ian's Rainfall

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Global warming has already increased precipitation in intense hurricanes. Lawrence Berkeley National Laboratory and Stoneybrook University did scientific analysis of how climate change factors contributed to Hurricane Ian's rainfall, issuing a rapid attribution statement on their findings. There was also analysis to quantify the resulting increase in both the saltwater flooding from the storm surge, as well as the freshwater flooding from inland rainfall.

Geomorphological Impact of Hurricane Ian along the Southwest Florida Coast

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Hurricane Ian, making landfall in Southwest Florida on September 28, 2022, severely impacted the coastal geomorphology of the region's barrier islands and attached beaches. Incoming storm surge, because of its extreme height, resulted in "inundation regime" impacts, placing the erosional capacity of wave energy well above the substrate. As a result, incoming surge resulted in sand deposition via overwash. Surge return, however, caused channelized erosion on the backshore and foredune. Small breaches were generated at multiple locations, but these too appear to have occurred during surge return. This presentation provides data on the storm's impact on that geomorphology by comparing LiDAR-generated digital elevation models before and after the storm.

Prior to the storm, geomorphology mapping was undertaken, using UAV-based LiDAR and ground-penetrating radar (GPR), to characterize the coast prior to a major event. That event, unfortunately, came too early with the passage of Ian, preventing a thorough assessment of the pre-storm condition. Nonetheless, this prescient research program provided unique insights into the storm's effect. Geographically, field work has focused, along the Lee and Collier County coasts, with more extensive work occurring on Sanibel, Fort Myers Beach, Lovers Key, and Naples. GPR was used to characterize subsurface lithosomes in recognized erosional hot spots from earlier storm impacts (e.g., surge channelization caused by Hurricane Charley on North Captiva, Santiva [westernmost Sanibel Island], and Lovers Key), and in depositional strandplains (e.g., Bowman's Beach, Sanibel; south Keewaydin). This provided stratigraphic signatures for comparison to lithosomes generated by Ian. LiDAR data were collected prior to Ian to produce digital elevation models (DEMs) for these areas. Post-Ian LiDAR flights are underway. Preliminary results demonstrate that massive landward transport and deposition of sediment occurred, which has grossly altered the topography of the backshore, foredune, and backdune. DEMs also document the return storm surge channelization of the foredune, backshore, and foreshore. Interestingly, these seaward-flow channels developed along the traces of anthropogenic trails cut across the dunes for beach access. GPR surveys of the post-Ian condition are scheduled for spring 2023 though not in time for the conference. Nonetheless, we believe the

storm-surge channels, recorded in GPR traces caused by former storms, also represent this same surge-return phenomenon.

A number of coastal jurisdictions (e.g., North Captiva, Sanibel, Fort Myers Beach, Naples) and natural resource management agencies (e.g., Rookery Bay National Estuarine Research Reserve, Ding Darling National Wildlife Refuge, Sanibel-Captiva Conservation Foundation) across the region have taken interest in this work. The pre-storm characterization research program started in late 2021 was developed in consultation with these groups. Our results will help the assessment of future vulnerability to the effects of climate change and inform restoration and redevelopment efforts for greater resilience.

Saltwater Impacts of Hurricane Ian in Storm Water Ponds

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Hurricane Ian hit Southwest Florida on September 28, 2022 causing a surge of marine water that flooded most areas in Fort Myers bordering the Caloosahatchee River and Estero Bay, among many other areas along the coast. Most of the seawater rise models predicted the water level impacts to these flood zones. The areas affected by the storm are heavily populated with subdivisions that require storm water ponds in their development permits. These storm water ponds become features that, in addition to flooding control, enhance property values for their residents. The Lee County Hyacinth Control District created in 1993 a volunteer monitoring program called “Pond Watch” which educates citizens in Lee County about better ways to manage and improve the conditions of their ponds. The devastating damage of Hurricane Ian affected many of our Pond Watch volunteer ponds. These ponds are being studied by Pond Watch in order to provide the best management actions to recover their functionality and aesthetics. This presentation will provide information about the damage caused by high salinity conditions, the methodology to assess these ponds and possible practices to remediate their conditions.

Session 3 – Climate and Economy & Food Supply

A Rising Tide Sinks All Homes: The Effects of Climate Change on Florida’s Economy

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Florida’s climate is changing, and this change poses an existential and generational threat to Florida. Rising global temperatures and sea levels greatly increase the risks to public health and safety, and to Florida’s economy. Florida’s continued growth will increase coastal populations and development, which will put still more people and property at risk. Absent measures to

mitigate these risks, rising temperatures and sea levels will result in devastating damages to every sector of Florida's economy.

In October 2021, Florida TaxWatch published "*A Rising Tide Sinks all Homes: The Effects of Climate Change on Florida's Economy*." Florida TaxWatch undertook this independent analysis to analyze the potential impacts of a changing climate on each of the 11 sectors that make up Florida's economy and to recommend appropriate policy changes to mitigate these impacts. There is no single measure to mitigate the devastating impacts of climate change on Florida's economy, and no region of the state or sector of the economy will be spared. Mitigating these economic impacts will require a comprehensive, multi-faceted strategy, which includes a mix of structural and non-structural measures. It will be expensive, but the costs of inaction will be much greater. By engaging in the policy debate now, Florida TaxWatch hopes to help shape a resilient Florida and a strong and vibrant Florida economy.

AgroClimate Indicators for Decision Making in Agriculture

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The AgroClimate project (http://agroclimate.org/) at the University of Florida works on developing new knowledge and decision support tools based on climate monitoring, short term, and seasonal forecasts, as well as long-term climate projections. Emphasis is given to developing methodologies for monitoring and forecasting the effects of extreme events, such as droughts, extreme temperatures, and heavy rainfall, on crop development and yield, as well as on the occurrence of plant diseases. During the last decade we have reviewed and identified climate indicators that are more relevant to agricultural producers' decision making in the southeast USA. Specialty crops that are grown in the region such as strawberry, blueberry, peaches, and citrus are the commodities that have made most use of the set of decision support tools available in the system. This presentation will discuss recent developments and plans for future AgroClimate decision support tools.

Adapting Food Systems to a 21st Century Climate

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21st Century extreme weather and climate change pose significant challenges for food systems. Unprecedented temperature and precipitation fluctuations, interconnected market shifts, and emergent plant pests and disease create cascading risks for communities and society. Natural and human-caused hazards will expose food system vulnerabilities the same as always. However, with supply chains growing longer and more complex, small-scale emergencies now have the potential to transform into large-scale crises. In order to avoid getting caught off guard in reactive mode, stakeholders should study a mix of adaptation options and be prepared to implement them proactively. This can limit impacts and build resilience. We present a handful of examples and discuss opportunities for partnership across regions and sectors.

Session 4 – Federal, State, and Local Resiliency

Keynote Address: Federal Resiliency Efforts

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Keynote Address: State Resiliency Efforts

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Creating a Heartland Regional Resiliency Coalition

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Heartland 2060: Building a Resilient Region is an award-winning grassroots visioning process that has guided the Heartland of Florida since 2007. Led by the Central Florida Regional Planning Council, participation includes DeSoto, Glades, Hardee, Hendry, Highlands, Okeechobee, and Polk counties and the municipalities within. A summary of the update of the Revisited plan was published in 2021 and can be found on the webpage at cfrpc.org.

To build on this foundational document and efforts, CFRPC and the seven inland Florida counties and partners launched the Heartland Regional Resiliency Coalition on April 1, 2022 to further address climate-related resiliency assessments and develop a Regional Resiliency Action Plan. This effort aims to protect critical infrastructure, build community resilience, promote economic stability, and enhance environmental resilience by creating guidelines for the development of resilient communities, identifying "Best Practices," and leveraging regional resilience efforts to reduce risk and enhance larger scale collaborative projects. The Heartland Coalition is the first entirely inland regional collaboration to address these issues, while adding to the resiliency planning portfolio by forecasting, assessing, and preparing for predictable and unpredictable change in the Heartland.

Legal and Policy Challenges for Adaptation to Climate Change

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Adaptation to climate change has both technical and implementation components. While we are getting better at the technical side in terms of how to predict future flood risk and impacts of other climate stressors and planning efforts are underway, an approach to comprehensive climate adaptation and implementation is still something we must confront. We cannot build our infrastructure the same way, we cannot allow development the same way, we cannot implement land acquisition programs the same way and we cannot manage our shorelines the same way.

The intersection of the technical information to provide the basis for better decision-making and the legal and policy approaches to implementing plans is upon us.

In many parts of the state, local governments have addressed the Peril of Flood amendments required for Coastal Elements in the Comprehensive Plan, but what about every other element in the Comprehensive Plan? Many of which contain policies that are no longer achievable and may expose the local government to liability for commitments to levels of service that just can't be met in the face of future flood risk. In some places in the state, we have changed requirements for stormwater design, but what about all other infrastructure design standards? There are good models for adapting or managing shorelines, but what is the relationship between that policy approach and allowing a private property owner to elevate their property with more fill, presumably in the floodplain? These policy challenges are not far off in the future, they are at our doorstep. We are simply not "done" with vulnerability and adaptation planning by creating a project list and pursuing grants to fund those projects.

This session will explore the need for more comprehensive adaptation implementation strategies and policy approaches with a note of caution on some of the legal implications for making those decisions (or not). We will discuss a broader scope of how to move from planning to implementation, mindful of our predominant challenge of facing future flood risk, and the legal implications we must consider as we move forward.

Session 5 – Coastal Waters Resiliency

Blue Carbon Incentives to Help Drive Restoration Needs in Tampa Bay

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The Tampa Bay region continues to rapidly urbanize with current metropolitan area population estimates exceeding 3.1 million people. By mid-century, population is expected to approach 5 million people within the ~5,700 km2 contributing watershed. The remaining native habitats face dualling pressures at the land-sea interface via this continuous urban development and recent sea-level rise trends. In response to these coastal stressors, the Tampa Bay Estuary Program (TBEP) has developed a restoration framework that focuses efforts on existing opportunities and establishes short-term (2030) targets and longer-term (2050) goals for the suite of habitats important to a healthy estuary. The cumulative loss of potentially restorable lands to both coastal and upland development underscores the diminishing restoration opportunities that currently exist in the watershed and the need to make investments now to protect and restore native habitats to achieve these goals in the future.

To further accelerate investments in coastal habitat restoration, the TBEP has previously quantified the long-term carbon sequestration benefits of "blue carbon" habitats. These "blue carbon" ecosystems, including seagrass, mangrove, salt marsh and salt barren habitats, are effective carbon sinks that sequester greenhouse gases from the atmosphere into their biomass and soils. The Tampa Bay Blue Carbon Assessment quantified existing carbon stocks of coastal habitats and identified their future carbon sequestration trajectories under varying climate change, coastal management, and habitat response scenarios. These scenarios helped to further

inform and prioritize restoration efforts, will support and enhance future coastal habitat management decisions, and potentially attract new funding partners to invest in future wetland restoration projects that offer additional climate change mitigation and adaptation benefits. The added carbon sequestration valuation of "blue carbon" habitats can help incentivize additional wetland restoration activities to help meet management targets in estuaries where these habitats currently exist and are projected to expand – if allowed.

Session 6 – Freshwater & Wetland Resiliency

The Importance of Freshwater Wetlands for Watershed Resilience

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Audubon researchers have documented an abrupt change in the hydrology of Corkscrew Swamp Sanctuary in the past 20 years. Analysis of 60 years of daily water level data indicates hydroperiods of habitats inundated into the dry season have been shortened by 2 to 2.5 months, with water level recession rates steeply increased and ground water levels falling significantly lower than those seen prior to 2000. The ecological consequences are dire, including reduction of Wood Stork nesting, reduced wetland functions and habitat values, increased risk of catastrophic wildfire, and loss of clean water supply for human and wildlife communities. The analysis led to collaboration amongst Audubon, Big Cypress Basin, and the SFWMD, to find both causes and solutions to this significant loss of watershed health in the CREW region using a hydrologic modeling study.

These studies, coupled with recent predictions of climate-change induced increases in evapotranspiration and trends in the annual flooding and wildfire cycle in places like Lehigh Acres and Golden Gate Estates, clearly point to the often overlooked importance of healthy inland watersheds to creating and enhancing climate change resilience in the wider Southwest Florida community, including along the coast. This is especially relevant as Southwest Florida local governments, the SFWMD, the US Army Corps of Engineers, and the State Office of Resilience all are funding studies and plans to address climate threats to human and natural communities. Working with nature in the form of inland watershed protection and restoration has a robust suite of resilience functions and outcomes that frequently are overshadowed by traditional discussions of coastal armoring, pumps, and drainage systems. Demographers predict another 15 million people will be in Florida by 2070, so there is urgency to securing and restoring the inland watersheds like the CREW system, Okaloacoochee Slough, Caloosahatchee watershed and the Kissimmee Valley before human coastal communities migrate inland to escape coastal climate impacts.

Watershed Resiliency Through One Water Planning

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The City of Winter Haven, also known as the Chain of Lakes City, is in the final phases of a One Water Master Planning effort. This plan is the blueprint of how a community can continue to grow, develop, and prosper while creating a sustainable and resilient future for generations to come. Winter Haven sits at the headwaters of the Peace River Watershed, and we take our location within the watershed seriously. Managing water resources collectively in our community will ultimately create positive impacts for downstream communities.

One of the signature projects the plan has generated is the Sapphire Necklace. This concept includes restoring 5000 acres of historic wetlands, recharging the aquifer, upgrading operations to generate more reclaimed water, and helping to balance the regional water cycle to reuse water most efficiently. Merging all aspects of water resource management will bolster the water supply for the region, minimize future flood situations, treat stormwater effectively, and restore hydrologically impaired waterbodies within the region, and encourage a more resilient community as we grow and develop.

The City is working with a willing land owner to create the first project within the overall Sapphire Necklace. This gem will showcase all aspects of the plan and will serve as an educational tool for future growth in Winter Haven, Florida and beyond. This presentation will highlight the multiple benefits each component of the One Water Master Plan provides as well as the role the Sapphire Necklace plays in the community and how the city plans to execute its first project.

Session 7 – Cultural Resources Resiliency

Creating a Disaster Risk Management Draft Plan for Pine Island Archaeological Site Complex

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Climate change is making hurricanes wetter, windier, and altogether more intense and as a result, there are more disaster risks. Disaster risks do not merely result from catastrophic events. There are underlying physical, social, economic, institutional, and attitudinal factors that create disaster risks and magnify them. Ever since Hurricane Ian impacted Southwest Florida in September 2022, many archaeological sites suffered significant damage and the preservation of archaeological sites has become more challenging. Unlike museum collections, archaeological sites, specifically mounds, cannot be sheltered from the impact of hurricanes. Mounds are immovable cultural assets that are exposed to many anthropogenic and environmental threats and Southwest Florida has an extensive number of archaeological mounds that are being threatened by climate change.

One such site is Pineland Archaeological Site Complex which is located at Bokeelia, Fl. and it is an outstanding complex made up of seven archaeological sites that are understood to have been one of the major towns of the native Indigenous people known as the Calusa. This area was distinguished by two sizable shell mound complexes that were divided by a water court and an artificial central canal. In order to mitigate the impact of hurricanes and other natural hazards on archaeological and cultural sites like Pineland, tools like a Disaster Risk Management Plan (DRM) can better help site managers and staff to prepare and respond to disasters. A DRM plan is not only concerned with the passive protection of heritage from disasters but also with a more proactive role that heritage can play in disaster mitigation, as a source of resilience and an asset for disaster risk reduction. However, a DRM should be an integrated component of the regular management systems of the heritage site, and it should also be linked to disaster management systems at the local, regional, and national levels. In this presentation, we discuss the impact that Hurricane Ian had on Pineland Archaeological Site Complex, the ongoing post-disaster recovery efforts, and the process of creating a Disaster Risk Management draft plan for the site.

Session 8 – Building Resiliency in Our Region

Everyday Resilience: Solutions from the Green Living Toolkit

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The health and well-being of our community depends on the health and resilience of our natural environment. As our population grows, so do the stresses on our environment and the natural systems that support us. We all care about environmental degradation and often wish somebody would do something about it. Sometimes, that somebody is all of us. The Science and Environment Council developed the Green Living Toolkit to help residents get laser focused on the most effective and achievable solutions for sustainable living on the Suncoast. The Green Living Toolkit (greenlivingtoolkit.org) is the first-of-its-kind essential guide to sustainable energy, food, waste recovery, water protection and nature assembled all in one place. The Toolkit includes the best step-by-step guides, tools, calculators, incentives and videos, plus local resources and experts who can assist and answer questions. The Toolkit's community-wide calendar consolidates environmental events from more than 100 local organizations such as sustainability classes, tours, festivals, and farmer's markets, as well as opportunities to volunteer or speak up for a cause. With each action, personal and community resilience grows — from your family's health and wellness to personal savings, property value, ecosystem health, and community prosperity.

What Are They Thinking?: A 2022 Climate Metrics Survey for Southwest Florida

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Advancing substantive policy and programs will require cooperation among stakeholders of different political leanings and values. To initiate constructive dialogue, it is important to understand the spectrum of beliefs and values held by stakeholders and identify common ground. In April of 2022, Growing Climate Solutions contracted a survey of climate beliefs and preference among 400 Southwest Florida residents. Findings from the survey have been used to frame and refine the organization's climate message. This presentation will summarize the 2022 survey findings and how we use this information to write, talk and present climate information to local constituents and policymakers.

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Uniting Central and Southwest Florida to Protect Water and Wildlife